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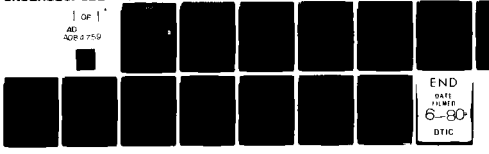

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VARIABILITY IN SHIPBOARD MORBIDITY RATES: ENVIRONMENTAL AND OCCUPATIONAL INFLUENCES

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REPORT NO. 76-70

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Variability in Shipboard Morbidity Rates: Environmental and Occupational Influences*

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The operational effectiveness of Navy ships depends upon two major components -- personnel readiness and materiel readiness. Medical support plays a key role in personnel readiness by (a) carrying out effective preventive measures to maintain the physical and mental well-being of crew members and to minimize illness and injury rates and (b) providing high standards of medical care to minimize disability and lost work time when illnesses or injuries do occur.

Previous studies have indicated considerably variability in morbidity rates aboard surface combat ships, even among ships of the same type deployed under similar operational conditions. Within ships' crews such demographic and occupational variables as age, length of service, pay grade, racial or ethnic group, marital status, education, and job specialty have been shown to relate significantly to illness rates during overseas deployments.[1,2,3]

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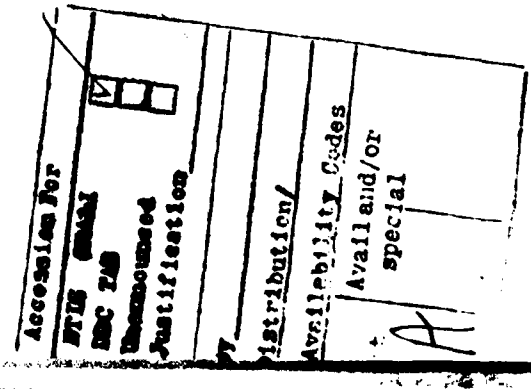

Important questions remain concerning environmental and occupational determinants of morbidity rates. Such questions are addressed in the present study in an effort to further delineate factors that influence shipboard morbidity. Identification of work environments and crew elements with high morbidity rates will permit the focusing of preventive or remedial efforts where most needed. The specific objective of this study, then, is to examine the variability of morbidity rates aboard Navy surface ships during overseas deployments and to identify major environmental and occupational factors associated with high illness incidence.

Method

Subjects were 4,012 Navy enlisted crew members of 18 surface combat ships -- 9 operating in the Western Pacific and 9 in the Atlantic and Mediterranean area. All ships were deployed during the same time period for a period of approximately 7 to 8 months. The Atlantic contingent consisted of three frigates, three destroyers, two guided missile destroyers, and one destroyer escort. The Pacific ships consisted of five destroyer escorts and four guided missile destroyers. The ships were generally comparable with respect to crew composition but varied somewhat in size (250 to 350 men) and considerably in age. The three destroyers were built during World War II while most of the destroyer escorts were commissioned in 1970 or 1971.

Research staff members administered questionnaires to crew members and established procedures for collecting medical and personnel data early in the ships' deployments. Illness data were recorded by the ships' medical departments using an individual reporting form (Sick Call Checklist) especially

designed for this study. These individual records provided information pertaining to job specialty, pay grade, work assignment (department or division), type of illness or injury, and amount of time lost from work. Illness rates were computed for specific categories of illness and for total illness episodes. Illness rate was expressed as the number of new illnesses per 1,000 men per day in order to control for variations in deployment duration and work group size. Mean illness rates were compared for various subgroups reflecting differences in environmental and occupational factors.

Results

Variability in morbidity rates was examined in relation to major environmental and occupational influences. The variables considered were geographical region, individual ship, department (work environment), and job level (*petty officer versus nonrated men*).

Geographic Region Effect. Illness rates for individual ships, grouped by geographic region (Atlantic or Pacific), are shown in Figure 1. The mean illness rate for the Pacific ships (19.4 visits) was higher than that for the Atlantic ships (14.9). The variability in reported morbidity was much greater among Atlantic ships (7.4 to 22.5) than among Pacific ships (14.4 to 22.8). Three of the Atlantic ships had extremely low reported incidence rates (10 or below).

(Insert Figure 1 about here.)

Specific illness rates by geographic region are shown in Table 1. The Pacific ships had slightly higher Respiratory and Dermal rates than Atlantic ships while Atlantic ships had slightly higher Trauma and Gastrointestinal

rates than Pacific ships. These trends appear to be of minor importance and do not suggest any marked differences in incidence for these conditions. However, there is a pronounced difference between geographical regions in the Venereal Disease/Genitourinary category. The VD rate is second in magnitude only to Respiratory illness for the Pacific ships while VD has by far the lowest incidence of any specific condition in the Atlantic sample. With the exception of Venereal Disease, then, the rates for specific illnesses generally are quite comparable for Pacific and Atlantic ships.

(Insert Table 1 about here.)

Individual Ship Effect. The wide variability in morbidity rates seen in Figure 1 strongly suggests that environmental and/or organizational differences among individual ships importantly affect illness incidence. Examination of morbidity rates by ship type (destroyers, guided missile destroyers, missile frigates, and destroyer escorts) revealed no important influence of this variable in total illness incidence. Thus, beyond any possible effects of geographic region and ship type on variability, characteristics of individual ships appear to be a significant source of variance in illness and injury rates. Specific environmental and organizational variables that may correlate with illness incidence have been described in a series of related reports.[4,5,6,7,8]

Department Effect. Destroyer-type ships have four major organizational subdivisions or departments: Weapons, Supply, Engineering, and Operations. Department assignment generally defines the type of physical environment in which the individual works. For purposes of the present analysis Deck

divisions, which on all ships are the largest component of the Weapons Department, were treated as a distinct organizational entity. Thus, illness rates were compared for Deck divisions and the Supply, Engineering, and Operations Departments. (On a few ships the Navigation or Communications group was designated as a separate department; in the present study these entities were always included in the Operations Department.)

(Insert Figure 2 about here.)

Differences in total illness rates by department and by geographical region are shown in Figure 2. There are consistent differences in morbidity rates by department for both geographic regions. The Operations Department has the lowest illness rate for both groups of ships and the Engineering Department the highest rate; Deck divisions have higher illness rates than the Supply Department in both comparisons. Department assignment (work environment) appears to have a major effect on illness rate with a range in the combined sample from 13.0 for the Operations Department to 19.5 for the Engineering Department.

In addition to physical environment, it might be expected that occupational experience would affect illness rates aboard ship, particularly accident rates. Differences in total illness rates by job level (petty officer versus nonrated) for each Department separately are shown in Figure 3. For all Departments the nonrated personnel have a much higher illness rate than the petty officer group. The discrepancy between petty officers and nonrated men is particularly large for the Deck divisions (13.5 for petty officers versus 21.7 for nonrated). It seems clear that physical environment and job experience both have an important influence on the risk of illness or

injury aboard surface combat ships.

(Insert Figure 3 about here.)

Department and Job Level Effects by Specific Illness Category. Illness rates by department and job level for major specific illness categories are shown in Figure 4. The relative impact of department and job level on illness incidence for each of these categories is of particular interest.

(Insert Figure 4 about here.)

Both department (work environment) and job level (experience) had some effect on Respiratory illness rate, but differences by job level tended to be quite small for the Operations and Engineering Departments.

For Dermal conditions job level was an important factor in illness rate, while the effect of department assignment was negligible.

For Trauma both work environment and job level affected incidence, but job level appeared to be more important than work environment in determining accident rate. This difference in Trauma rates by job level was most pronounced for the Deck divisions.

VD rate was moderately affected by both department and job level, but job level was the more important factor.

The incidence of Castrointestinal disorders was not affected appreciably by either department or job level. In other words, the risk of Gastrointestinal illness was essentially the same for all segments of the crew.

Discussion

The difference in overall morbidity rates between Atlantic and Pacific ships was partly explained by the relatively high rate of Venereal Disease in

the Pacific area. When VD rates were subtracted from total illness rates, the remaining difference in illness rates was small (15.4 for Pacific versus 14.5 for Atlantic). To explore the question of regional differences in the risk of illness further, attention was focused on the three Atlantic ships that exhibited very low reported rates. It seemed possible that extraneous factors present in the situation might account for these extreme deviations in reported morbidity.

Using information available from related studies conducted on the same sample of ships, comparisons were made of the medical departments of these ships. One of the two corpsmen on Atlantic Ship No. 1, the ship with the lowest reported illness rate, was himself ill during an extended period of the deployment. It seems plausible that crew members may have avoided visits for minor complaints during this time and, thus, underutilized the medical facilities on this ship.

Atlantic Ships No. 2 and No. 3, which reported very low illness incidence, both had extremely unfavorable scores on a questionnaire scale that measured crew members' perceptions of the quality of medical care.[7] It seems likely that the medical facilities on those ships were underutilized because of the crew's low level of confidence in the medical staff. Also, one of these ships reported much higher dispensary visit rates (200% to 300% higher) to the Bureau of Medicine and Surgery in routine monthly reports than were reflected in the individually recorded research data, suggesting grossly inaccurate illness reporting on this ship.

Thus, for three of the Atlantic ships it appeared that medical facilities were underutilized, resulting in low estimates of illness incidence. The

difficulties of obtaining accurate outpatient morbidity data aboard surface combat ships have been previously noted.[9] The use of an individual record card (Sick Call Checklist) in the present study represented an important advance in the accuracy of recording outpatient medical data aboard ship (see reference 4 for a description of this card), but further improvements in the Sick Call Checklist are needed and are now being evaluated. Whatever methodology for recording outpatient visits is used, it seems essential to obtain relevant information about living and working conditions aboard individual ships and about the medical departments of those ships in order to adequately evaluate deviations in reported morbidity.

It is clear from the present results that morbidity aboard Navy combat ships is strongly affected by work environment. Engineering Department personnel had much higher illness and injury rates than Operations Department personnel. While it was true that men who worked in the Engineering Department generally were exposed to hot, noisy, and dirty environments and men who worked in the Operations Department generally experienced more comfortable and pleasant environments, the specific environmental factors that account for the differences in illness and injury rates are unknown.

Experience also was an important factor in overall health and safety in that petty officers had much lower rates of illness than nonrated men in all departments. The factor of experience tended to have a differential effect with respect to the type of morbidity: Experience had a marked effect on injury rate, moderate effects on Dermal and Venereal Disease incidence, a slight effect on Respiratory illness rate, and no effect on Gastrointestinal illness rate. It might be hypothesized that those illness conditions most

affected by experience would be most amenable to prevention and control, that is, educational and managerial interventions.

The present findings leave many unanswered questions. For example, what are the specific physical characteristics that make work environments unsafe or unhealthy? What organizational influences, such as supervisory attitudes and practices or co-worker relationships, moderate the effects of physical environment on health and safety? How much of the variability in morbidity rates is accounted for at the department or division level rather than the ship level? What factors affect the accuracy of illness reporting?

The need for a morbidity forecast model to predict casualties during operational deployments has been proposed recently by the authors,[4] and a general social system model for representing man-environment interactions in naval organizations is in the process of development.[6,10] These formulations should provide a detailed conceptual framework and methodology for addressing issues such as those raised in the present study.

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Footnote

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Table 1

Morbidity Rates by Geographical Region and Specific Illness

Illness Category	Atlantic	Pacific
Respiratory	4.5[a]	5.9
Trauma	3.6	3.1
Dermal	2.2	3.0
Venereal/Genitourinary	0.4	4.0
Gastrointestinal	2.3	1.6
Other	1.9	1.8
Total Illnesses	14.9	19.4

[a]The number of new cases per 1,000 men per day.

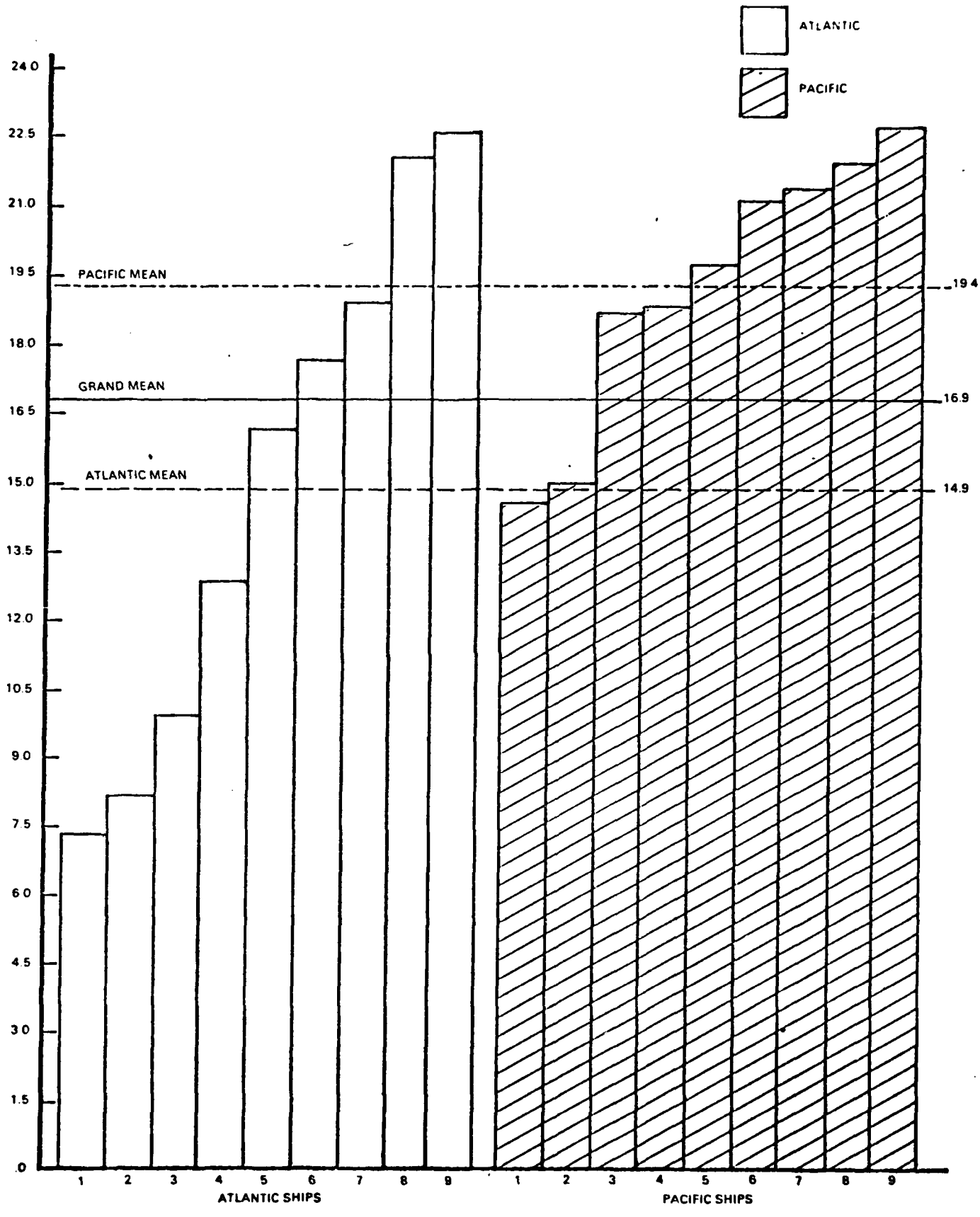


Figure 1. Illness Rates by Individual Ship, Grouped by Geographic Region.

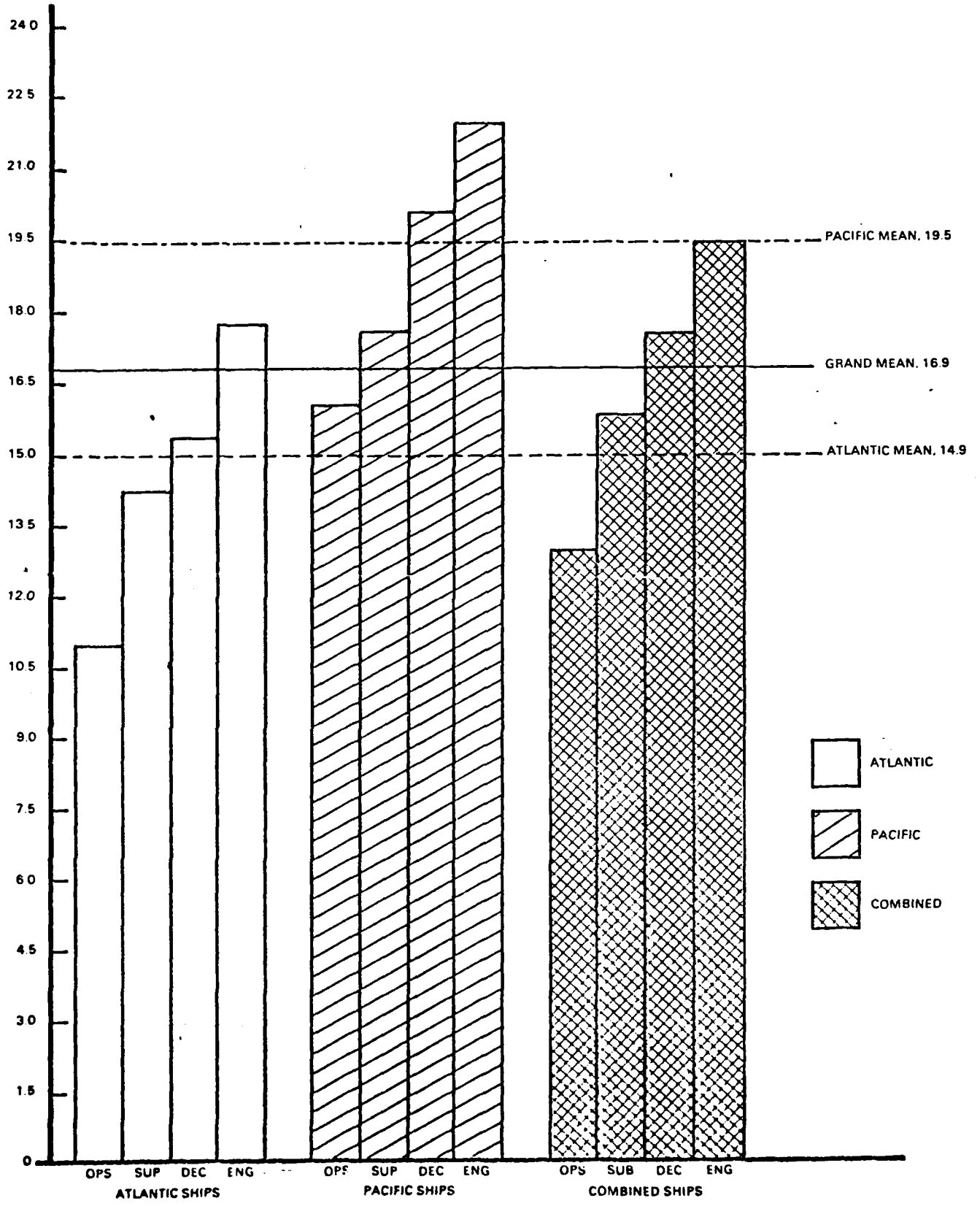


Figure 2. Illness Rates by Geographic Region and Department.

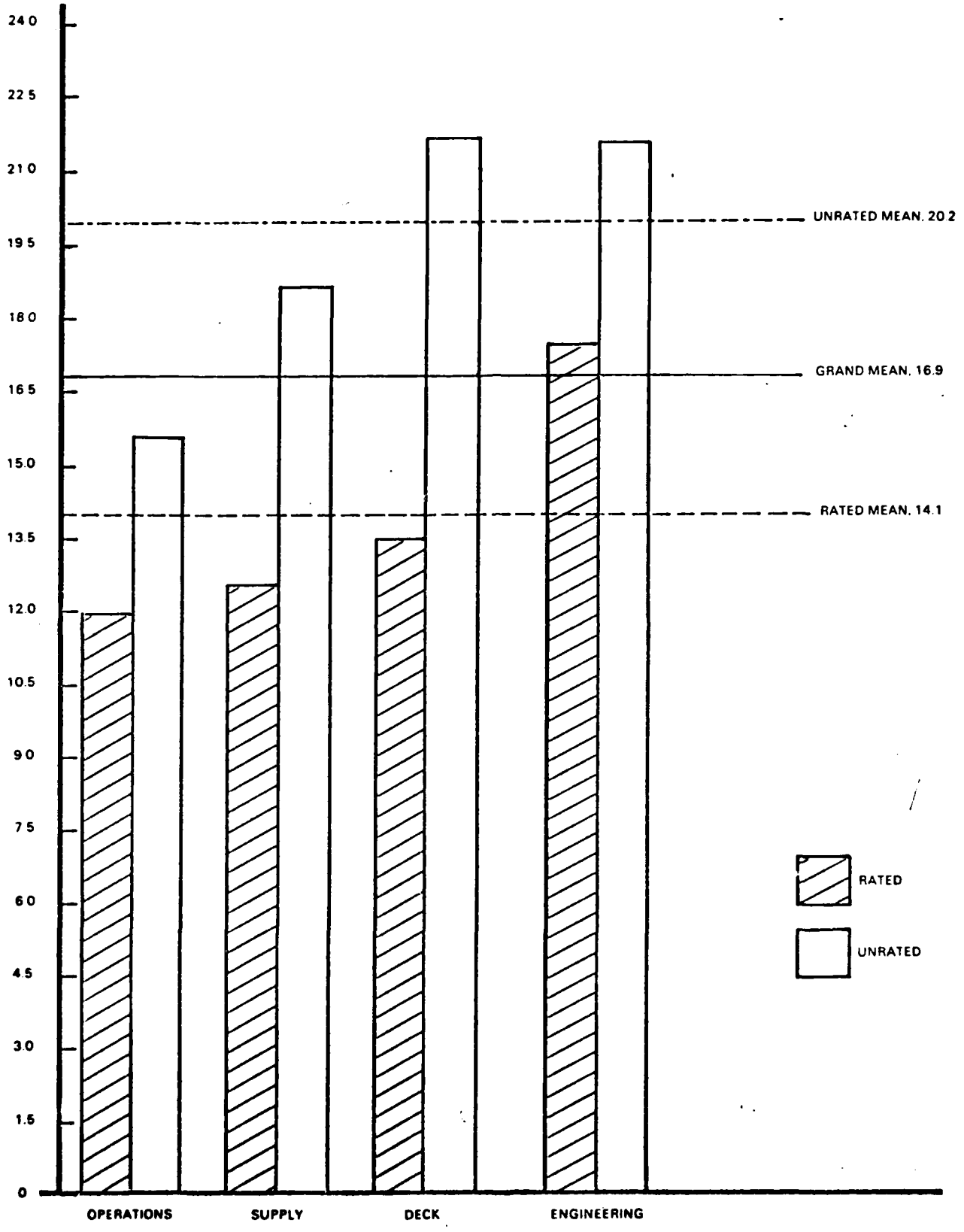
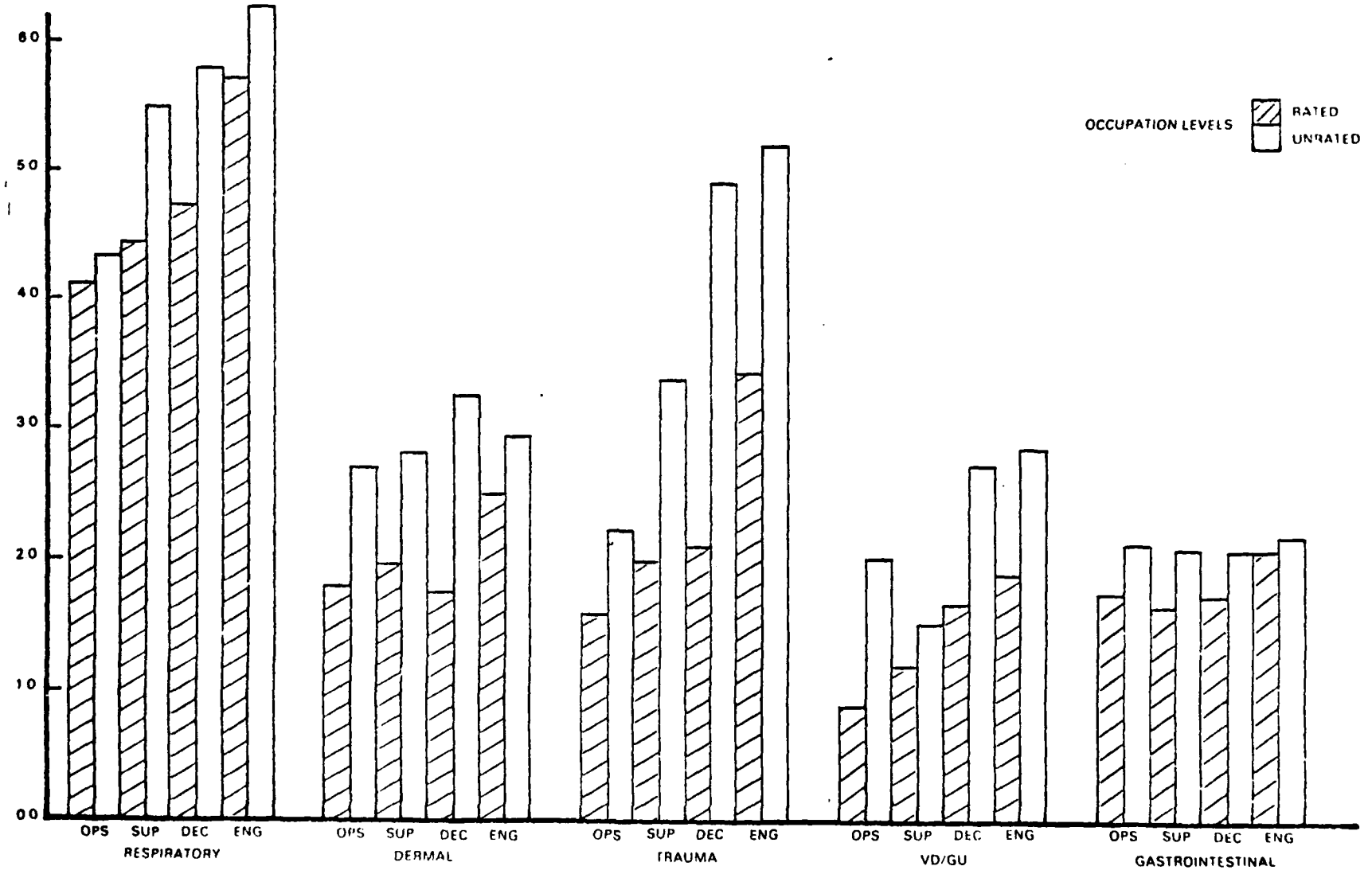


Figure 3. Illness Rates by Department and Job Level



Figures 4. Specific Illness Rates by Department and Job Level

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Morbidity rates were examined for 18 surface combat ships deployed to the Pacific and Atlantic areas. Variability in morbidity was evaluated in relation to geographical region, individual ship, department (work environment), and job level (petty officer versus nonrated). An observed difference in overall morbidity between Atlantic and Pacific appeared to be explained by a large difference in VD rate and underutilization of medical facilities or underreporting of illnesses on three Atlantic ships. Both department assigned

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and job level strongly affected total illness and injury rates, and job level had a differential effect with respect to specific type of morbidity. A comprehensive conceptual framework and methodology is needed to address the many unanswered questions in this area of research.